Test Procedure

TP 308

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Horiba CVS Verification by Propane Tracer Gas Injection	1 of 17
Originator	**Supersedes**
Bob Moss	N/A
Responsible Organization	**Computer Program**
Ozone/PM Vehicle Group	N/A
Type of Test Report	**Data Form Number**
EPA Propane Injection Report	N/A
Report Distribution	**Implementation Date**
N/A	11-15-99

Implementation Approval

Original Test Procedure Authorized by EPCN #218 on 11-15-99

Revision Description

Note: Specific brand names in this procedures re for reference only and are not an endorsement of those products.

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Attachments

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1. Purpose

The purpose of this procedure is to describe the equipment and procedure required to perform a Propane Injection Procedure using the Horiba Mexa-7200 Automotive Emission Analysis System. To verify the accuracy and integrity of the Constant Volume Sampler (CVS), a known mass of propane gas is injected into the system and is compared to the mass indicated by detection of a Flame Ionization Detector (FID). This test procedure is commonly referred to as a propane Tracer Gas Injection (TGI). The calibration verification is performed weekly, or after any maintenance which could alter calibration, to ensure that the equipment has not shifted out of acceptable tolerance limits.

2. Test Article Description

Constant volume vehicle exhaust sampling system and emissions analyzer bench

3. References

3.1 "Code of Federal Regulations," Title 40, Part 86, Subpart B, Sections 89.119 and 86.116

3.2 Horiba Constant Volume Sampler Operation Manual

3.3 "Horiba Chassis Dynamometer Test Control System (CDTCS) Manual"

3.4 Environmental Protection Agency (EPA) current safety policies

3.5 "Horiba MEXA 7000 Series Training Manual"

3.6 "Horiba Series 7000 User Guide"

3.7 "Instruction Manual for the Critical Flow Orifice Kit, Model 210;" Horiba Instruments, Inc.; November 1978

4. Required Equipment

4.1 Horiba MEXA 7200 Exhaust Gas Analyzers

4.2 Horiba Constant Volume Sampler

4.3 Instrument-grade propane

4.4 Horiba Critical Flow Orifice (CFO) Kit, Model 210, with disbursing injection probe

4.5 4.14 Test Cell Ambient monitoring system:

4.5.1 Type “J” thermocouple and temperature/millivolt transmitter, or thermocouple thermometer connected to a strip chart recorder

4.5.2 Dew-Point Hygrometer located in the test cell.

4.5.3 Digital barometer, centrally located

4.6 CVS Compressor unit (Blower)

5. Precautions

5.1 The test cell floor is checked for gasoline spills.

5.2 The CVS blower must be operating when performing the test.

53 Cylinders containing compressed gases are used for this procedure. The technician must be familiar with the “EPA Laboratory Safety Manual” sections dealing with the safe handling, storage, and use of compressed gas cylinders.

Safety precautions must be followed when using compressed gases.

5.4 The CFO kit must be in the test cell prior to the start of the calibration for a minimum of 20 minutes to ensure the kit is at room temperature.

6. Visual Inspection

6.1 The test cell floor is checked for gasoline spills.

6.2 There should be no vehicle(s) on the dynamometer(s) and the test cell door is closed.

6.3 The test cell air handler should be on and test cell ambient conditions are stable.

6.4 The gas cylinder and equipment is checked for leakage, damage, and cleanliness.

6.5 The CFO pressure gauge is reading zero while the kit is not operating.

6.6 Calibrations are checked as valid by verifying that the calibration due dates have not been exceeded for the CFO kit and strip chart recorders.

6.7 The power is turned on for the HC analyzer (i.e., FID) and related equipment.

6.8 The FID is lit and allowed to warm-up for a minimum of 30 minutes.

6.9 All documentation needed to operate the FID for the verification is present.

7. Test Article Preparation

7.1 In the test cell:

Ensure that the air handling system in the test cell is turned on and test cell ambient conditions are stable,

Inspect the test cell floor for gasoline spills,

Ensure that there are not any vehicle(s) on the dynamometer(s) and the test cell door is closed.

7.2 In the control room, if necessary, activate the Horiba Mexa 7200 Bench.

7.3 Ensure that the CDTCS computer is turned on.

7.4 Bring the CFO kit into the test cell, position it near the CVS, and allow the kit temperature to stabilize for about 15 minutes.

7.5 Check the gas cylinder and equipment for leakage, damage, and cleanliness.

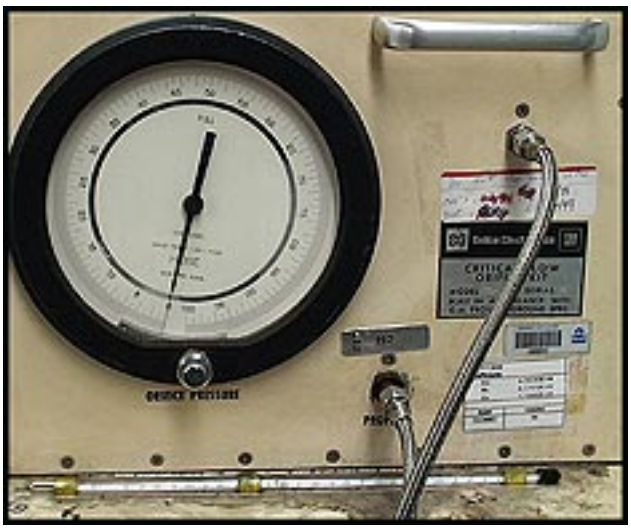
7.6 Check that the CFO pressure gauge is reading zero while the kit is not operating. Adjust if necessary.

7.7 Connect the line from the CFO Kit to the Critical Flow Venturi (CFV)-CVS inlet. See the arrow in Figure 1.

Figure 1
CFO Connection to the CVS

7.8 Ensure that all openings in the CVS inlet pipe are closed.

7.9 Open the propane gas cylinder valve and allow the CFO pressure gauge to stabilize at a constant pressure for a minimum of 15 minutes. The stabilized pressure should be between 75 and 80 psig. See Figure 2. If the pressure does not stabilize, readjust the propane gas cylinder valve to a stable pressure between 75 and 80 psig.



8. Test Procedure

101 In the control room, on the command screen of the Horiba Master Control Unit (MCU) computer in the control room, click on “Line.” See the arrow in Figure 3. From the resulting menu, click on “Dilute.” See the circle in Figure 3.

102 On the MCU command screen , click on “Standby”.” See the arrow in Figure 4. From the menu, click on “Online.”.

See the circle in Figure 4.

Figure 4
Select Online

103 On the CDTCS computer main screen, click on “Testrun.” See the circle in Figure 5.

When the menu appears, click on “Test Schedules.”

Figure 5
Test Schedules

104 From the list of files on the CDTCS computer “Test Schedule File Selection Dialog” screen, highlight “Propane Injection.” See the Circle in Figure 6. Click on “Run Test.” See the arrow in Figure 6.

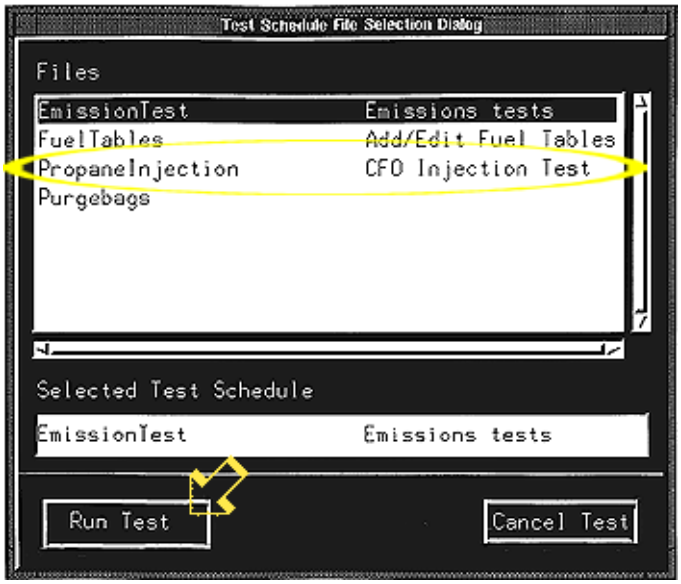


Figure 6
Select Propane Injection

105 On the “Run CFO Kit Editor” menu, click on “No.” See the arrow in Figure 7.

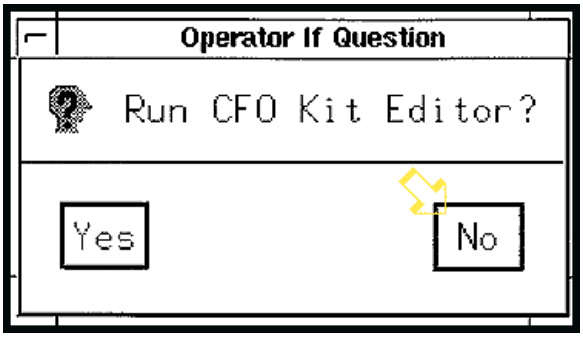


Figure 7
CFO Kit Editor

106 On the “Select a CFO Kit” menu, highlight the number for the CFO kit being used. See the circle in Figure 8. Click on “Enter.” See the arrow in Figure 8.

Figure 8
CFO Kit Number

107 On the “Pre Test Entries” menu: Click in the “Operator ID” field and use the keypad to enter your operator ID number. See the field labeled “A” in Figure 9. Click on the correct “Bag #,” where # equals 1, 2, 3 or 4. See the fields next to “B” in Figure 9. For “Bag Fill Time,” click in the field and use the keypad to enter 300. See the field labeled “C” in Figure 9. Click on the “Enter” button. See the arrow in Figure 9.

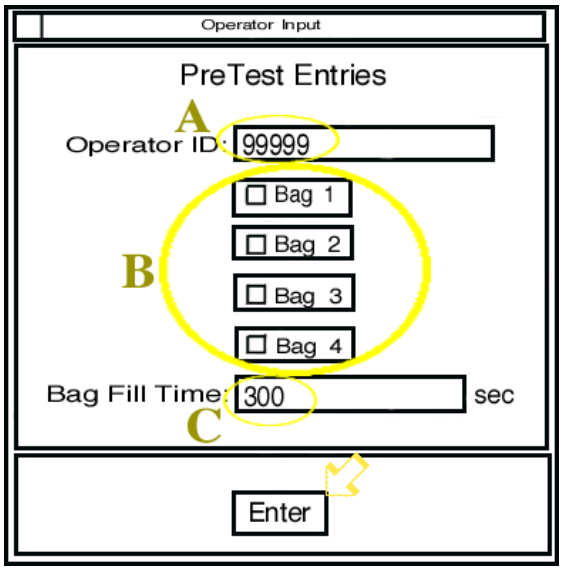


Figure 9
Pretest Entries

108 On the “Please Select Flow Rate” menu, highlight the 350 CFM (or 500 CFM, or 850 CFM). See the circle in Figure 10. The chosen flow rate will appear in the “Selection” field. Click on Enter. See the arrow in Figure 10.

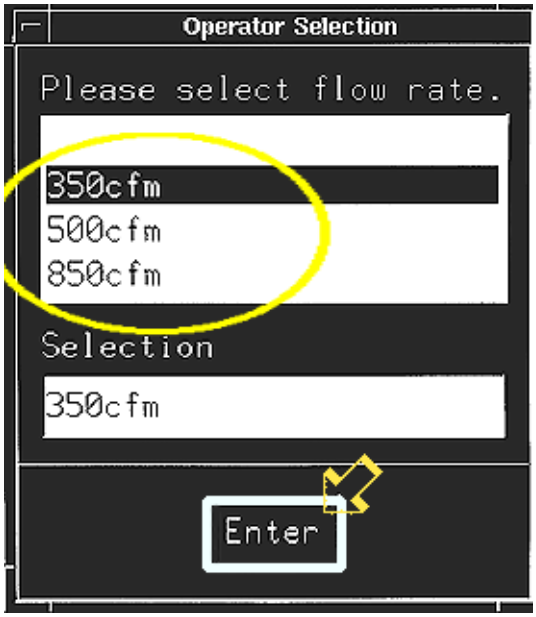


Figure 10
Select Flow Rate

109 When the “Start Gas Flow on CFO Kit” dialog box appears, click on “OK.” See the arrow in Figure 11. Go into the test cell and note the CFO pressure and temperature for use in the next step.

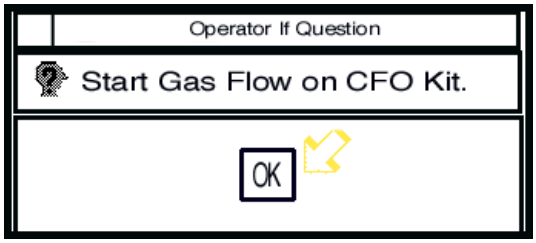


Figure 11
Start Gas Flow on CFO Kit

110 Click in the proper fields in the “Enter Initial Values” menu, use the keypad to enter the initial CFO pressure and initial CFO temperature noted in Step 109.
See the circle in Figure 12.

Click on “Enter.” See the arrow in Figure 12.

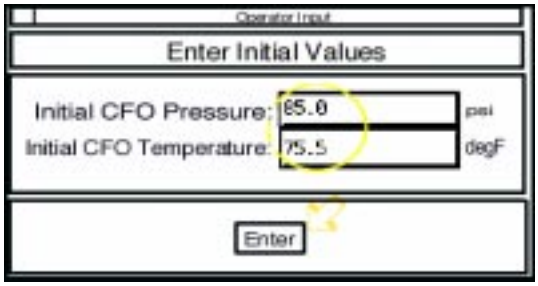


Figure 12
Enter Initial Values

111 The Tracer Gas Injection test will automatically begin and the “Horiba Real Time Display” will provide a running account of the test status and data.

See Figure 13.

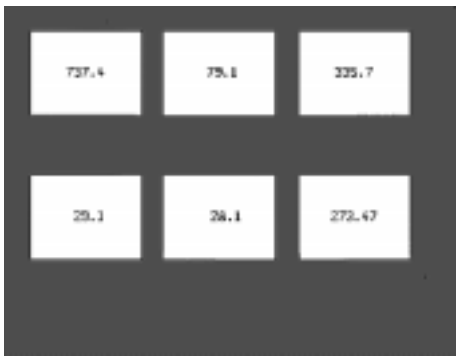


Figure 13
Horiba Status Display

112 At the end of the test the “Enter Final Values” menu will appear. Go to the test cell and note the CFO pressure and temperature.

Return to the CDTCS computer, click in the proper fields, and use the keypad to enter the final CFO pressure and final CFO temperature.

See the circle in Figure 14.

Click on “Enter.”

See the arrow in Figure 14.

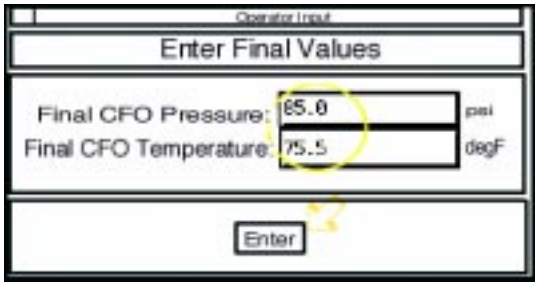


Figure 14
Enter Final Values

113 In the “Printer Control” dialog box, click on “Print.”

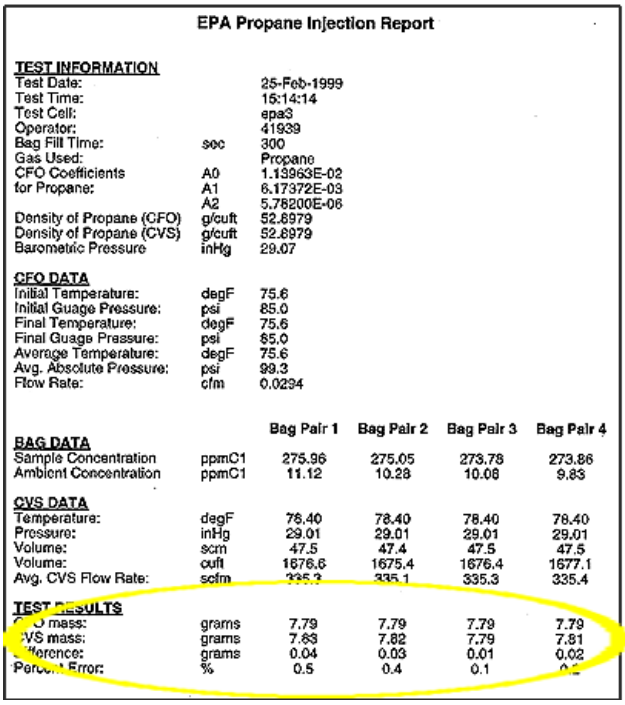
See the arrow in Figure 15.

Figure 15
Select Print

114 On the "EPA Propane Injection Report," verify that the CVS mass is within ±2.0% of the CFO mass. See the circle in Figure 16.

If the error is more than ±2.0% of the mass injected by the CFO kit, go to Step 109 and perform the procedure again. If, after the second attempt the error is not within ±2.0% of the mass injected by the CFO kit, consult with the VT senior technician for corrective action.

If, after the second attempt the propane mass sampled is within ±2.0% of the mass injected by the CFO kit, go to Step 109 and perform the procedure again. Two consecutive tests with the CVS mass within ±2.0% of the CFO mass are required after a failed test.



EPA Propane Injection Report

TEST INFORMATION						
Test Date:		25-Feb-1999				
Test Time:		15:14:14				
Test Cell:		epa3				
Operator:		41939				
Bag Fill Time:	sec	300				
Gas Used:		Propane				
CFO Coefficients	A0	1.13963E-02				
for Propane:	A1	6.17372E-03				
	A2	5.78200E-06				
Density of Propane (CFO)	g/cuft	52.8979				
Density of Propane (CVS)	g/cuft	52.8979				
Barometric Pressure	inHg	29.07				
CFO DATA						
Initial Temperature:	degF	75.6				
Initial Guage Pressure:	psi	85.0				
Final Temperature:	degF	75.6				
Final Guage Pressure:	psi	85.0				
Average Temperature:	degF	75.6				
Avg. Absolute Pressure:	psi	99.3				
Flow Rate:	cfm	0.0294				
			Bag Pair 1	**Bag Pair 2**	**Bag Pair 3**	**Bag Pair 4**
BAG DATA						
Sample Concentration	ppmC1		275.96	275.05	273.78	273.86
Ambient Concentration	ppmC1		11.12	10.28	10.06	9.83
CVS DATA						
Temperature:	degF		78.40	78.40	78.40	78.40
Pressure:	inHg		29.01	29.01	29.01	29.01
Volume:	scm		47.5	47.4	47.5	47.5
Volume:	cuft		1676.6	1675.4	1676.4	1677.1
Avg. CVS Flow Rate:	scfm		335.3	335.1	335.3	335.4
TEST RESULTS						
CFO mass:	grams		7.79	7.79	7.79	7.79
CVS mass:	grams		7.83	7.82	7.79	7.81
Difference:	grams		0.04	0.03	0.01	0.02
Percent Error:	%		0.5	0.4	0.1	

Figure 16
Test Report

115 If no more injections are scheduled, turn off the propane kit.

116 If testing is completed, turn off the CVS blower after the kit pressure has fallen to zero. See the arrow in Figure 17.

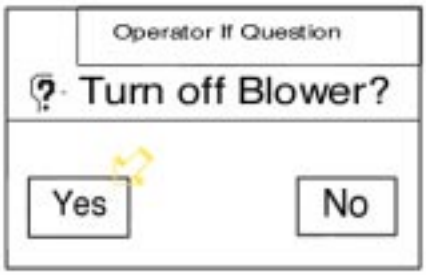


Figure 17
Turn Off Blower

117 Disconnect the CFO inlet connector and tailpipe pressure line connector. Remove the kit from the cell and turn off the air handler.

9. Data Input

9.1 On the “Pre Test Entries” menu, the operator enters:

9.1.1 His/her operator ID in the “Operator ID” field.

9.1.2 “Bag Fill Time”

9.2 On the “Please Select Flow Rate” menu, the operator highlights the correct flow rate.

9.3 On the “Enter Initial Values” menu, the operator enters the initial CFO pressure and initial CFO temperature .

9.4 On the “Enter Final Values” menu the operator enters the final CFO pressure and final CFO temperature observed in the test cell.

10. Data Analysis

10.1 The technician verifies the data on the “EPA Propane Injection Report” for completeness and accuracy.

10.2 The technician checks to ensure all acceptance criteria (Section 12) have been met.

If all criteria have been met, the technician prints the “EPA Propane Injection Report”.

If all criteria have not been met, the technician takes corrective action where necessary and repeats the entire test procedure .

11. Data Output

11.1 An “EPA Propane Injection Report” is generated after the test.

11.2 The verified “EPA Propane Injection Report” is filed by the technician in the site log.

12. Acceptance Criteria

12.1 The propane mass sampled must be within ±2.0% of the mass injected by the CFO kit.

12.2 CVS system verification must be performed weekly, or after any maintenance which could alter calibration.

13. Quality Provisions

13.1 The technician checks to ensure all acceptance criteria (Section 12) have been met.

13.2 The technician verifies the data on the “EPA Propane Injection Report” for completeness and accuracy.

13.3 Two consecutive tests with the CVS mass within ±2.0% of the CFO mass are required after a failed test.

13.4 The CFO kit must be in the test cell, positioned near the CVS, and the kit temperature allowed to stabilize for about 15 minutes.

13.5 The air handling system in the test cell must be turned on and test cell ambient conditions must be stable.

13.6 All openings in the CVS inlet pipe must be sealed.

13.7 The line from the CFO kit must be connected to the CFV-CVS inlet.

13.8 The CFO pressure gauge should be allowed to stabilize at a constant pressure between 75 and 80 psig.

EPA Propane Injection Report

TEST INFORMATION

Test Date:		25-Feb-1999
Test Time:		15:14:14
[illegible]:		epa3
[illegible]erator:		41939
Ba[illegible] Time:	sec	300
Gas U[illegible]d:		Propane
[illegible] Coefficients	A0	1.13963E-02
for Propane:	A1	6.17372E-03
	A2	5.76200E-06
Density of Propane (CFO)	g/cuft	52.6979
Density of Propane (CVS)	g/cuft	52.6979
Barometric Pressure	inHg	29.07

CFO DATA

Initial Temperature:	degF	75.6
Initial Guage Pressure:	psi	85.0
Final Temperature:	degF	75.6
Final Guage Pressure:	ps[illegible]	85
Average Temperature:	de[illegible]	7[illegible]
Avg. Absolute Pressure:	ps[illegible]	[illegible]
Flow Rate:	cf[illegible]	0.0[illegible]94

		Bag Pair 1	Bag Pair 2	Bag Pair 3	Bag Pair 4
BAG DATA					
Sample Concentration	ppmC1	275.96	275.05	273.78	273.86
Ambient Concentration	ppmC1	11.12	10.28	10.08	9.83
CVS DATA					
Temperature:	degF	78.40	78.40	78.40	78.40
Pressure:	inHg	29.01	29.01	29.01	29.01
Volume:	scm	47.5	47.4	47.5	47.5
Volume:	cuft	1676.6	1675.4	1676.4	1677.1
Avg. CVS Flow Rate:	scfm	335.3	335.1	335.3	335.4
TEST RESULTS					
CFO mass:	grams	7.79	7.79	7.79	7.79
CVS mass:	grams	7.83	7.82	7.79	7.81
Difference:	grams	0.04	0.03	0.01	0.02
Percent Error:	%	0.5	0.4	0.1	0.2

SAMPLE

Print Time: 25-Feb-1999 15:53:31 Test Time: 25-Feb-1999 15:14:14 Page 1